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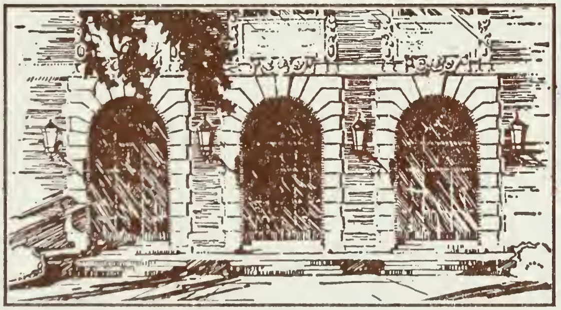

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AERONAUTICS BULLETIN NO. 23

Aviation Ground Instructor Curriculum

UNIVERSITY OF ILLINOIS BULLETIN

UNIVERSITY OF ILLINOIS INSTITUTE OF AVIATION

UNIVERSITY OF ILLINOIS INSTITUTE OF AVIATION

Leslie A. Bryan, Ph.D., LL.B., Director
Gertrude A. Becker, Editor

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Aviation Ground Instructor Curriculum

By LESLIE A. BRYAN, Director, and EUGENE L. HAAK, Instructor

Institute of Aviation, University of Illinois

Foreword

From time to time the Institute of Aviation has published bulletins of an informational nature, though directed to a relatively small segment of the aviation field. In this type of public service the Institute has been joined often by The Link Foundation. The Foundation provided funds for the publication, several years ago, of a series of bulletins which were directed toward aiding schools and colleges, as well as others, in developing flight and preflight instruction programs. These apparently were helpful and fulfilled an existing need.

It is now apparent that a need exists for the development of a curriculum for instructors who wish to teach preflight or ground school courses to persons learning to fly. The Civil Air Regulations have also made changes in the requirements for the Ground Instructor certificate and ratings which are of considerable consequence. We are therefore glad to make our experience in this field available through this bulletin, for which The Link Foundation has again provided the publication funds.

In this monograph, as in all similar publications of the Institute, the authors have had complete freedom to express their opinions, with the understanding that they assume full responsibility therefor.

October 1962 LESLIE A. BRYAN, *Director*

629.13
Il6a
no. 23

Contents

INTRODUCTION 5

CERTIFICATES AND RATINGS 5

APPLICANT QUALIFICATIONS 6

AVIATION GROUND INSTRUCTOR CURRICULUM 7

Introduction

The passage of time, with its steady increase of knowledge in the field of aviation, and the complexities of air traffic rules and more aircraft instrumentation have brought a need for more extensive ground school or preflight instruction. This has been recognized by the Federal Aviation Agency (FAA) in its recent revision of rating requirements, by prospective pilots preparing for the FAA examinations, and by the schools who are giving such instruction. Aeronautical instructors are in demand. It is looking to the aid in their development that the following is offered.

Certificates and Ratings

A Ground Instructor certificate with appropriate rating or ratings is required of anyone who is teaching in an FAA approved school. The regulations governing the ratings are covered in Part 51 of the *Civil Air Regulations,*[1] which provides that anyone who meets the requirements will be issued an FAA Ground Instructor certificate with one or more of the three ratings provided for therein. These ratings are (1) *Basic,* which qualifies the holder to instruct in a basic pilot ground school, (2) *Advanced,* which qualifies the holder to instruct in both the basic and advanced pilot ground schools, and (3) *Instrument,* which qualifies the holder to instruct in an instrument flying school and to operate instrument flight simulators.

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[1] The Civil Air Regulations (CAR) are being recodified in new form to be called the *Federal Aviation Regulations.* Recodification is being done on a schedule which will be completed by August 1963. Until superseded by the new regulations, current provisions of the CAR remain in effect.

Once granted, the certificate is good for an indefinite period or until suspended or revoked by the FAA. As a matter of practice, all certificates or ratings are usually granted by FAA representatives on a basis of 60 days' duration. The elapsing of this time, without notification to the contrary, makes the certificate valid for the indefinite period noted above.

Applicant Qualifications

To qualify for the certificate, the applicant must be at least 18 years of age and possess sufficient aeronautical knowledge to pass the written examination for the pertinent rating. There are no citizenship requirements which have to be met. There are no prerequisites which must be complied with previous to taking the examination. After passing the examination, an FAA application must be completed in order to receive the certificate. This form may be obtained from any FAA District Office or from any FAA General Operations Inspector.

For the original issuance of the certificate, the applicant must pass a written examination on the fundamentals of instruction and a written examination appropriate to the rating sought. For additional ratings, an applicant must pass only the written examination appropriate to the rating sought. If a person holds a currently effective teacher's certificate issued by a city, county, or state, he does not have to take the examination on the fundamentals of instruction. In the curriculum suggestions that follow, it is assumed that many of the students will have had some educational theory courses or, if not, that they will be able to gain that knowledge by reading from some of the sources indicated so that only a few hours need to be spent on that subject. It is also assumed that the instructor has current theoretical and practical knowledge of the subjects taught in the curriculum and that the students have at least some informational knowledge of the fields. The curriculum has been designed to prepare the student for the examination for the *Advanced* rating and to fit the two-semester college year, with each semester providing 45 clock hours of classroom instruction.

Aviation Ground Instructor Curriculum

The outline for a two-semester course is as follows:

FIRST SEMESTER

FUNDAMENTALS OF INSTRUCTION **3 HOURS**

References

Burton, William H., *The Guidance of Learning Activities,* 3rd edition. New York: Appleton-Century-Crofts, Inc., 1962.

Zweng, Charles A., *The 7 Ground Instructor Ratings,* 10th edition. North Hollywood, Calif.: Pan American Navigation Service, 1961.

Syllabus

I. LESSONS AND METHODS OF TEACHING
  A. Development lesson
  B. Drill lesson
  C. Demonstration lesson
  D. Lecture
  E. Topical lesson
  F. Discussion lesson
  G. Inductive lesson
  H. Deductive lesson

II. LESSON PLANS
  A. Importance
  B. Preparation
  C. Application

III. QUALITIES OF AN INSTRUCTOR
  A. Personality
    1. Appearance
    2. Voice and speech
    3. Cheerfulness and vitality
    4. Courtesy
    5. Self-control
  B. Professional traits
    1. Master of subject
    2. Executive ability
    3. Skill in teaching

IV. TYPES OF STUDENTS
  A. Slow learner
  B. Fast learner
  C. Inattentive and troublesome
  D. Stallers and side-trackers
  E. Dawdlers and time-wasters

    - F. Chronic objectors and faultfinders
    - G. Know-it-alls
- V. PROCESS OF LEARNING
    - A. Laws of learning
    - B. Importance of student activity
    - C. Self-activity
    - D. Interest

CIVIL AIR REGULATIONS[1] 16 HOURS

References

Civil Air Regulations: Parts 3, 18, 20, 40, 41, 42, 43, 50, 51, and 60.

CAB Safety Investigation Regulations: Part 320.

Flight Standards Service Release No. 457.

Flight Information Manual.

The above publications may be obtained from the U.S. Government Printing Office, Washington 25, D.C.

Syllabus

- I. GROUND INSTRUCTOR CERTIFICATE
    - A. Requirements for application and issuance
        - 1. General
        - 2. Examinations and re-examination
    - B. Duration
    - C. Display
    - D. Recent experience
    - E. Change of address
- II. PILOT AND FLIGHT INSTRUCTOR CERTIFICATES
    - A. General requirements
        - 1. Application and issuance
        - 2. Citizenship
        - 3. Prerequisites for examinations and tests
        - 4. Re-examination after failure
        - 5. Duration of certificates
        - 6. Aircraft used in flight tests
    - B. Pilot certificates; airplane, rotorcraft, and glider ratings
        - 1. Student
            - a. Age
            - b. Education
            - c. Physical standards
            - d. Requirements for solo flight
            - e. Flight area limitations
        - 2. Private
            - a. Age

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[1] See footnote on page 5.

        - b. Education
        - c. Physical standards
        - d. Aeronautical knowledge
        - e. Aeronautical experience
        - f. Aeronautical skill
    - 3. Commercial
        - a. Age
        - b. Education
        - c. Physical standards
        - d. Aeronautical knowledge
        - e. Aeronautical experience
        - f. Aeronautical skill
- C. Special issuance of pilot certificates
    - 1. Graduates of certificated airmen agencies
    - 2. Military competence
    - 3. Foreign pilot certificate
- D. Aircraft ratings
    - 1. Category
    - 2. Class
    - 3. Type
- E. Additional aircraft ratings
    - 1. Category
    - 2. Class or type
- F. Instrument rating
    - 1. Aeronautical knowledge
    - 2. Aeronautical experience
    - 3. Aeronautical skill
- G. Flight Instructor certificate
    - 1. Requirements
    - 2. Records

III. GENERAL OPERATION RULES
- A. Aircraft
    - 1. Documents required in aircraft during flight
    - 2. Aircraft nationality and registration marks
        - a. General
        - b. Display
        - c. Location
        - d. Color
        - e. Affixation
        - f. Design
        - g. Maintenance
        - h. Removal
    - 3. Transport category airplane weight limitations

        4. Maintenance
            a. Mechanic authorization
                (1) Persons authorized to perform maintenance, preventative maintenance, repairs, and alterations
                (2) Persons authorized to approve maintenance, repairs, and alterations
                (3) Persons authorized to perform and approve one-hundred hour, periodic, and progressive inspections
            b. Flight tests
            c. Inspections
            d. Aircraft and engine maintenance records
            e. Rebuilt engine logs
        5. Requirements for instruments and equipment
        6. Aircraft electronic navigation equipment accuracy
    B. Piloting rules
        1. Pilot certificate
        2. Medical certificate and renewal
        3. Operation during physical deficiency
        4. Use of liquor, narcotics, and drugs
        5. Towing by aircraft
        6. Dropping objects or persons
        7. Aerobatic flight
        8. Parachutes
        9. Transportation of explosives and other dangerous articles
        10. Fuel supply
    C. Student pilot limitations
        1. General limitations
        2. Aircraft limitations
        3. Recent experience
    D. Private and Commercial pilot privileges and limitations
        1. General
            a. Private pilot
            b. Commercial pilot
        2. Rating requirements
        3. Flight instruction limitations
        4. Instrument flight limitations
        5. Simulated instrument flight
        6. Recent flight experience
IV. AIR TRAFFIC RULES
    A. General
        1. Scope
        2. Operation over the high seas

    3. Authority of the pilot
  - B. General Flight Rules
    1. Application
    2. Preflight action
    3. Careless or reckless operation
    4. Avoidance of prohibited and restricted areas
    5. Right-of-way
    6. Proximity of aircraft
    7. Acrobatic flight
    8. Minimum safe altitude
    9. Operation on and in the vicinity of an airport
    10. Air traffic control instructions
    11. Notification of arrival
    12. Adherence to air traffic clearances
    13. Water operations
    14. Aircraft lights
    15. Flight test
    16. Altimeter setting
    17. Flight crew members at controls
  - C. Visual flight rules
    1. Basic VFR minimum weather conditions
    2. Special VFR minimum weather conditions in control zone
    3. VFR cruising altitudes
    4. VFR flight plans
  - D. Instrument flight rules
    1. Application
    2. IFR flight plans
    3. Alternate airport
    4. Air traffic clearance
    5. IFR cruising altitudes
    6. Course to be flown
    7. Instrument approach procedures
    8. Radio communications
    9. Radio failure

V. AIR TRAFFIC CONTROL PROCEDURES
  - A. Airport traffic control procedures
    1. Request for change in clearance
    2. Responsibility for avoidance of collision
    3. Airport traffic and taxi patterns
    4. Landing and takeoff
    5. Withholding takeoff clearance
    6. Light signal procedures for airport traffic control

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- B. Security control procedures
  - 1. Air Defense Identification Zones
    - a. VFR flights
    - b. IFR flights
    - c. Communications equipment required
    - d. Adherence to flight plan or air traffic clearance
    - e. Allowable tolerances
    - f. Exceptions
    - g. Recommended ADIZ practice
    - h. Emergency situations
  - 2. SCATER

VI. NOTIFICATION AND REPORTING OF AIRCRAFT ACCIDENTS AND OVERDUE AIRCRAFT

- A. Responsibility of the Civil Aeronautics Board
  - 1. General
  - 2. Aid requested from Federal Aviation Agency
- B. Applicability of Part 320, CAB Safety Investigation Regulations
- C. Notification and reporting to the Civil Aeronautics Board
  - 1. Notification requirements
  - 2. Reporting requirements
  - 3. Preservation of aircraft wreckage and records
  - 4. Notification of overdue aircraft
- D. Notification and reporting to the Administrator of the Federal Aviation Agency
  - 1. Notification requirements
  - 2. Reporting requirements
  - 3. Preservation of aircraft wreckage and records
  - 4. Notification of overdue aircraft

VII. SPECIFIC OPERATIONS

General description of content

- 1. CAR, Part 40
- 2. CAR, Part 41
- 3. CAR, Part 42

VIII. AIRMAN AGENCY CERTIFICATE

- A. Certificate
  - 1. School ratings
  - 2. Application
  - 3. Issuance
  - 4. Display
  - 5. Duration
  - 6. Renewal

        7. Transfer
    B. Requirements
        1. Ground school requirements
        2. Ground school curriculum
        3. Flying school requirements
        4. Flying school curriculum
        5. Quality of instruction
        6. Student examination
        7. Records
        8. Graduation certificates
        9. Inspection
        10. Curriculum changes
        11. Maintenance of facilities, equipment, and material
        12. Advertising
        13. Change of location
        14. Examining authority

NAVIGATION — 20 HOURS

References

Lyon, Thoburn C., *Practical Air Navigation.* Annapolis, Md.: Aeronautical Services, Inc., 1955.

Federal Aviation Agency, *Pilot's Radio Handbook.* U.S. Government Printing Office, Washington 25, D.C., 1962.

Equipment

Sectional Aeronautical Chart
World Air Chart
Radio Facility Chart
Plotter
Computer

Syllabus

I. POSITION AND TIME ON THE EARTH'S SURFACE
    A. Latitude
        Parallels
    B. Longitude
        Meridians
    C. Time zones
II. CHART PROJECTIONS
    A. The curved surface of the earth on flat charts
    B. Properties obtainable in a projection
    C. Types of projection
        1. Lambert Conformal Conic projection
        2. Mercator Conformal projection

III. DISTANCE
  - A. Great circle
  - B. Rhumb line
  - C. Nautical mile
  - D. Statute mile

IV. CHART READING
  - A. Topographical information
  - B. Aeronautical data
  - C. Miscellaneous

V. INTRODUCTION TO THE METHODS OF NAVIGATION
  - A. Pilotage
  - B. Dead Reckoning
  - C. Radio
  - D. Celestial

VI. DEAD RECKONING
  - A. True course
    - 1. Definition
    - 2. Measuring direction
    - 3. Measuring distance
  - B. Magnetic course
    - 1. Definition
    - 2. Variation
  - C. Airspeed
    - 1. Indicated
    - 2. Calibrated
    - 3. True
  - D. Altitude
    - 1. Indicated
    - 2. Pressure
  - E. True heading
    - 1. Definition
    - 2. The wind triangle
      - a. Drift angle
      - b. Drift correction angle
  - F. Ground speed
    - 1. Definition
    - 2. The wind triangle
    - 3. Estimated time enroute (ETE) and estimated time of arrival (ETA)
  - G. Magnetic heading
    - 1. Definition
    - 2. Variation

- H. Compass heading
  - 1. Definition
  - 2. Deviation
- I. Problems
  - 1. Making good a course
  - 2. Time, speed, and distance
  - 3. Fuel consumption
  - 4. Climb and descent
  - 5. Making good an ETA
  - 6. Finding the wind
  - 7. Tracking
  - 8. Radius of action
  - 9. Alternate airport
  - 10. Off-course correction

VII. RADIO

- A. Facilities
  - 1. VHF Omnidirectional Range
  - 2. L/MF Radio Range
  - 3. L/MF Beacon
  - 4. Instrument Landing System (ILS)
  - 5. Precision Approach Radar (PAR)
  - 6. Airport Surveillance Radar (ASR)
  - 7. Airways
- B. Airborne equipment
  - 1. Omni receiver
  - 2. Loop antenna
  - 3. Automatic Direction Finder (ADF)
  - 4. ILS receiver
- C. Omni
  - 1. Frequencies
  - 2. Identification
  - 3. Determining line of position
  - 4. Determining position
  - 5. Tracking
  - 6. Time and distance to station
- D. Radio Range
  - 1. Frequencies
  - 2. Identification
  - 3. Signal pattern
  - 4. Cone of silence
  - 5. Markers
    - a. Frequency

            - b. Types
                - (1) Z
                - (2) Fan
                - (3) Dumbbell
    - E. ADF
        - 1. Facilities
            - a. Radio Range
            - b. Beacon
            - c. Standard broadcast station
            - d. ILS compass locator
        - 2. Use of ADF
    - F. ILS
        - 1. Frequencies
        - 2. Identification
        - 3. Signal pattern
            - a. Localizer
            - b. Glide slope
        - 4. Other components
            - a. Outer and middle markers
                - (1) Frequency
                - (2) Identification
            - b. Compass locators
                - (1) Frequencies
                - (2) Identification
        - 5. Flying the ILS
    - G. ASR and PAR
        - 1. General description
        - 2. Procedure
        - 3. Communications

RADIO COMMUNICATIONS 4 HOURS

References

Flight Information Manual.

Airman's Guide.

Pilot's Radio Handbook, 1962.

The above publications may be obtained from the U.S. Government Printing Office, Washington 25, D.C.

Syllabus

- I. FACILITIES
    - A. Functions and frequencies
        - 1. Control Tower
            - a. Local control
            - b. Approach control
            - c. Ground control

        2. Flight Service Station
        3. Air Route Traffic Control Center

- II. PHRASEOLOGY AND TECHNIQUES
- III. USE OF EMERGENCY FREQUENCIES

USE OF AIRMAN'S GUIDE — 2 HOURS

Reference

Airman's Guide.

Syllabus

- I. DIRECTORY OF AIRPORTS
- II. RADAR-RADIO LISTINGS
- III. NOTICES TO AIRMEN (NOTAMS)
- IV. SPECIAL NOTICES

SECOND SEMESTER

METEOROLOGY — 12 HOURS

References

Pilot's Weather Handbook, CAA Technical Manual No. 104.
Meteorology for Naval Aviators, Navaer 00-80V-24.
All-Weather Flight Manual.
The above publications may be obtained from the U.S. Government Printing Office, Washington 25, D.C.

Syllabus

- I. THE ATMOSPHERE
    - A. The three parts
    - B. Composition
- II. HEAT AND TEMPERATURE
    - A. Temperature as a measure of heat
        - 1. Fahrenheit
        - 2. Centigrade
    - B. How the atmosphere is heated and cooled
        Effects of different types of earth's surface
    - C. Temperature lapse rate
- III. MOISTURE
    - A. The temperature-moisture relationship
        - 1. Capacity of warm air to hold more water vapor than colder air
        - 2. Relative humidity
        - 3. Dew point
    - B. Change of state
        - 1. Evaporation
        - 2. Condensation
    - C. Supercooled water

- IV. Adiabatic Lapse Rates
  - A. Dry
  - B. Wet
  - C. Stability
- V. Clouds
  - A. How clouds are formed
  - B. Cloud types
  - C. Cloud families
- VI. Pressure
  - A. Measuring pressure
    - 1. The barometer
    - 2. Station pressure
    - 3. Sea-level pressure
  - B. Pressure variation
  - C. Isobars
  - D. The altimeter
- VII. General Circulation
  - A. Wind belts
  - B. Forces acting on the atmosphere
  - C. Highs and lows
    - 1. Aloft
    - 2. At the surface
- VIII. Air Masses
  - A. Definition
  - B. Source region
  - C. Classification
  - D. Characteristics
  - E. General paths of movement
  - F. Modification
- IX. Fronts
  - A. Definition
  - B. Basic characteristics and associated weather
    - 1. Cold
    - 2. Warm
    - 3. Stationary
    - 4. Occluded
- X. Thunderstorms
  - A. The life cycle
    - Characteristics of each stage
  - B. In-flight considerations
  - C. Ground operation considerations
- XI. Icing
  - A. Cause

- B. Conditions under which icing is likely
- C. Effect on aircraft

XII. TURBULENCE
- A. Convection
- B. Wind
- C. Wind shear
- D. Aircraft wake

XIII. FOG

Conditions for likely formation and general characteristics
1. Radiation fog
2. Advection fog
3. Frontal fog

XIV. AVIATION WEATHER REPORTS

Date, time, and frequency of issuance — read and interpret
1. Sequence report
2. Winds aloft report

XV. AVIATION WEATHER FORECASTS

Date, time, and frequency of issuance — read and interpret
1. Area forecast
2. Terminal forecast
3. Winds aloft forecast

XVI. WEATHER MAPS AND CHARTS

Date, time, and frequency of issuance — read and interpret
1. Surface weather map
2. Winds aloft chart
3. Constant-pressure charts

AIRCRAFT 20 HOURS

References

Maintenance, Repair, and Alteration of Airframes, Powerplants, Propellers, and Appliances, Civil Aeronautics Manual 18. U.S. Government Printing Office, Washington 25, D.C.

Bryan, Leslie A., and others, *Fundamentals of Aviation and Space Technology.* Urbana, Ill.: University of Illinois Institute of Aviation, 1962.

Van Sickle, Neil D. (Ed.), *Modern Airmanship.* Princeton, N.J.: D. Van Nostrand Co., Inc., 1957.

Syllabus

I. STRUCTURE OF AIRCRAFT
- A. Stresses and strains
  1. Basic types of stresses
     - a. Tension

- b. Compression
- c. Bearing
- d. Bending
- e. Torsion
- f. Shear

- 2. Key stress points
  - a. Yield point
  - b. Ultimate stress
  - c. Proportional limit
  - d. Margin of safety

- B. Fuselage
  - 1. General types of construction
    - a. Framework
    - b. Stressed-skin
      - (1) Monocoque
      - (2) Semi-monocoque
  - 2. Construction members
    - a. Skin
    - b. Stringer
    - c. Longeron
    - d. Ring
    - e. Frame
    - f. Bulkhead
- C. Wing
  - 1. Basic construction
    - a. Cantilever
    - b. Semi-cantilever
  - 2. Components
    - a. Spar
    - b. Rib
    - c. Skin
      - Stressed-skin construction
    - d. Stringer
    - e. Drag wire
- D. Stabilizers
  - 1. Vertical
  - 2. Horizontal
- E. Control surfaces
  - 1. Ailerons
  - 2. Rudders
  - 3. Elevators
  - 4. Flaps
  - 5. Tabs

- F. Control cables and pulleys
- G. Nacelles
    - 1. Engine mounts
    - 2. Cowling and fairing
- H. Landing gear
    - 1. Shock struts
    - 2. Wheels and tires
    - 3. Brakes

II. THEORY OF FLIGHT

- A. Forces acting on an airplane
    - 1. Lift
        - a. How airfoil produces lift
        - b. Angle of attack
            - (1) Chord
            - (2) Relative wind
        - c. Speed
        - d. Center of lift
        - e. Stall
        - f. High-lift devices
    - 2. Weight
        - a. Turning
        - b. Turbulence
    - 3. Thrust
    - 4. Drag
        - a. Wing
        - b. Parasite
- B. Lift-drag ratio
- C. Axes of movement
- D. Stability
- E. Load factors
- F. Changes in load factors and stalling speed with basic maneuvers
- G. Weight and balance

III. MAINTENANCE

- A. General
    - 1. Persons authorized to perform maintenance, preventative maintenance, repairs, and alterations
    - 2. Persons authorized to approve maintenance, repairs, and alterations
    - 3. Persons authorized to perform and approve 100-hour, periodic, and progressive inspections
    - 4. Aircraft operating limitations

B. Maintenance, repair, and alteration records
  1. Required records and entries
  2. Content of repair and alteration records
  3. Form and disposition of major repair or major alteration records
  4. Form and disposition of periodic and progressive inspection records

C. Performance rules
  1. General standard of performance
    a. Maintenance and repair
    b. Alterations
    c. Inspections
  2. FAA interpretation of general standard of performance
    a. Wood aircraft structures
    b. Fabric covering
    c. Metal aircraft structures
    d. Control cables and terminals
    e. Bolts, screws, and miscellaneous fasteners
    f. Corrosion protection, cleaners, and paint removers
    g. Identification and inspection of material
    h. Aircraft equipment
    i. Windshields and enclosures
    j. Hydraulic system
    k. Electrical systems
    l. Instruments

AIRCRAFT ENGINES 13 HOURS

Reference

Aircraft Powerplant Handbook, CAA Technical Manual No. 107.

Syllabus

I. PRINCIPLES OF OPERATION

The four-stroke cycle engine
  1. Intake stroke
  2. Compression stroke
  3. Power stroke
  4. Exhaust stroke

II. ENGINE PERFORMANCE

A. Power
  1. Horsepower (HP)
  2. Brake mean effective pressure (BMEP)
  3. Indicated mean effective pressure (IMEP)
  4. Indicated horsepower (IHP)
  5. Friction horsepower (FHP)

    6. Brake horsepower (BHP)
    7. Manifold Pressure (MP) and revolutions per minute (RPM)
        a. Relation to power
        b. Proper use
  B. Ratings
    1. Need for operating limits
    2. Ratings for continuous operation
    3. Recommended limits of operation
    4. Ratings for time-limited conditions
    5. Takeoff
  C. Detonation
    1. Effecting factors
        a. Fuel characteristics
        b. Fuel-air ratio
        c. Manifold pressure
        d. Intake air temperature
        e. Cylinder head temperature
    2. Detection
    3. Prevention
  D. Preignition
    1. Effecting factors
        a. Intake air temperature
        b. Cylinder head temperature
  E. Power charts
  F. Power curves
  G. Efficiency criteria

III. ENGINE DESIGN AND CONSTRUCTION
  A. Design
  B. Parts and functions
    1. Parts and functions
    2. Valves and valve springs
    3. Valve mechanism
    4. Piston assemblies
    5. Connecting rods
    6. Crankshaft assemblies
    7. Bearings
    8. Crankcase assemblies
    9. Intake manifold
    10. Exhaust manifold
    11. Vacuum pumps
  C. Classification and Description of Engine Types
    1. In-line

        2. V
        3. Opposed
        4. Radial
    D. Cylinder numbers
    E. Firing order

IV. FUELS AND FUEL SYSTEMS
    A. Combustion
        Materials and products
    B. Fuel
        Gasoline
            a. Volatility
            b. Octane and performance number rating
            c. Purity
    C. Fuel systems
        1. Basic circuits
            a. Tanks
            b. Lines and fittings
            c. Valves and dials
            d. Strainers
            e. Pumps and relief valves
        2. Priming system
            a. Multiple point
            b. Diffuser
            c. Adapter
        3. Carburetion
            a. Principles
                (1) Fuel-air ratio
                (2) Vaporization
                (3) Mixture vs. exhaust flame
            b. Distribution of fuel-air mixture
            c. Carburetor construction and operation
                (1) Basic parts
                (2) Mixture control
                (3) Idle cutoff
                (4) Accelerating pump
                (5) Economizer
                (6) Idling system
            d. Carburetor heat
        4. Supercharging systems
            a. General principles and operation
            b. Secondary effects of supercharging
            c. Types of systems

V. IGNITION SYSTEMS
  A. Magneto
    1. Induction coils
    2. Breaker assembly
    3. Condenser
    4. Distributor
    5. Switch
  B. Wiring
  C. Spark plugs
    1. Construction
    2. Operating temperature control
    3. Failures
    4. Reconditioning
  D. Timing

VI. LUBRICATION AND OIL SYSTEM
  A. Description and classification of mineral lubricants
  B. Properties of lubricating oils
    1. Viscosity
    2. Flash point
    3. Chemical stability
    4. Pour point
    5. Additives
  C. Requirements of aircraft engine oils
    1. General descriptions and operation
      a. Wet sump
      b. Dry sump
    2. Units
      a. Supply tank
      b. Lines and fittings
      c. Oil filter
      d. Temperature regulator
      e. Pressure pump
      f. Relief valve
      g. Pressure gauge
    3. Oil dilution system

VII. COOLING SYSTEM
  A. Effects of high operating temperature
  B. Fundamentals of air cooling
  C. Limiting temperature
  D. Temperature indication
  E. Temperature control
    1. Cowl flaps

        - 2. Air speed
        - 3. Fuel-air ratio
        - 4. Power

VIII. STARTING SYSTEM
- A. Inertia starter
- B. Direct cranking starter

IX. ELECTRICAL SYSTEM
- A. Function
- B. Basic components
    - 1. Generators
        - a. Types
            - (1) Alternating current
            - (2) Direct current
        - b. Construction principles
            - (1) Field frame
            - (2) Armature assembly
            - (3) Brushes and brush holders
    - 2. Regulators
        - a. Voltage
        - b. Current
    - 3. Batteries

X. PROPELLERS
- A. General principles
- B. Types
    - 1. Fixed-pitch
    - 2. Adjustable-pitch
    - 3. Controllable-pitch
    - 4. Constant-speed

XI. GENERAL OPERATION
- A. Starting
- B. Warm up
- C. Engine check
- D. Takeoff and climb
- E. Cruising
- F. Landing
- G. Taxiing
- H. Stopping

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